

JULY 2019



**WIM #45
CSAH 14, MP
10.1
BLAINE, MN**

**MONTHLY
REPORT**



Your Destination...Our Priority



WIM Site Location

WIM #45 is located on CSAH 14 near Blaine in Anoka county.

System Operation

WIM #45 was operational for the entire month of July 2019. Volume was computed using all monthly data.

System Calibration

WIM #45 was most recently calibrated on 2016-01-19. Table 1 summarizes the front axle weights of class 9s by lane ¹. Figure 1 shows the distribution of gross vehicle weights (GVW) in Class 9 vehicles at this site for the last 12 months of operation ². Figure 2 depicts the average front axle weight as a percent difference from the first full month following calibration.

Summary of Volume Statistics

Total Monthly Volume: 404321 | Passenger Vehicles: 393924 | Heavy Commercial Vehicles: 10397

Monthly Average Daily Traffic (MADT): 12901 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 335

See Table 2 for vehicle class breakdown

Passenger Vehicles (PVs) and Heavy Commercial Vehicles (HCVs)

Volume trends. EB vehicles typically reached highest volume levels on Wednesdays, with lowest volumes reported on Sundays. WB vehicles typically reached highest volume levels on Wednesdays, with lowest volumes reported on Sundays (see Figure 3 and 4).

Passenger Vehicles (PVs)

Volume trends. On an average 24-hour day (see Figure 5), EB PVs generally reached peak volume levels between 07 AM and 05 PM. Similarly, WB PVs peaked in volume between 03 PM and 05 PM

Heavy Commercial Vehicles (HCVs)

Volume trends. On an average 24-hour day, HCVs traveling EB typically reached peak volume levels between 07 AM and 05 PM, while volume going WB peaked between 03 PM and 05 PM. See Figure 6. Out of all HCVs, the two highest traffic volumes were generated by Class 5's and Class 6's.

Overweight HCVs

Volume trends. Of a total of 10397 HCVs, 754 of them were overweight ³. These overweight HCVs contributed to 0.2% of total monthly volume, and 7.3% of total monthly

HCV volume. EB overweight vehicles typically reached highest numbers on Mondays, with lowest volumes reported on Sundays. WB overweight vehicles tended to reach highest volumes on Tuesdays, with lowest volumes reported on Sundays. See Figure 3 .

The top two overweight violators by class were the class 6 and class 9 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 60.4% of all overweight vehicles traveling EB this month (see Figure 7 & 8). Figure 9 shows the number of vehicles exceeding 88,000 pounds that crossed the WIM over the last 12 months. The highest number of 88,000+ vehicles within the last 12 months occurred in June.

WIMs are currently used as a screening tool for weight enforcement, and it is estimated that the WIM scales can measure gross vehicle weights (GVW) within 90-95% of static weight scale measurements. Due to the possibility of measurement error, vehicles exceeding 10% of their legal weight limits (or 1.1 times their legal weight limits) are considered overweight in this report ⁴.

Using normal load limits ,57 EB vehicles exceeded 88,000 pounds (26 vehicles were Class 13's; 25 vehicles were Class 10's). Of vehicles traveling WB,

19 EB vehicles exceeded 88,000 pounds (8 vehicles were Class 10's; 6 vehicles were Class 13's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from July 2019.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in July 2019. Data suggests that there were greater numbers of fully_loaded Class 9's than empty Class 9's traveling EB, while there were more fully_loaded Class 9's than empty traveling WB. Data also suggests that there were more fully_loaded Class 10's than empty traveling in the EB direction. In the WB direction, there were more fully_loaded class 10 vehicles.

Freight Totals. A total of 62440 tons of freight was recorded to have crossed the WIM. More freight was shipped EB (62.9%) than WB (37.1%). See Table 4 and Figure 11 for more freight information.

####Infrastructure Considerations Bridge. Bridge No. 02051 (a prestressed concrete beam span) is approximately 2.8 miles west of WIM #45 on CSAH 14, and Bridge No. 02006 (a prestressed concrete beam span) is approximately 5.2 miles east of WIM #45 on CSAH 14. WIM #45 recorded a total of 404321 vehicles with a combined GVW of 2044980 kips (1 kip = 1,000 pounds = 0.5 tons) in July 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 4932 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 62.3% of all ESALs were recorded EB while 37.7% was observed WB. In particular, 25% of all ESALs were generated by the Class 6's (Class 6's were also responsible for generating 3% of total GVW observed this month). See Table 6 and Figures 14-15 for more information on ESALs (Table 6 also provides flexible ESAL factors for each vehicle class using a terminal serviceability of 2.5 and a structural number of 5).

#####WIM monthly reports can be found at:

<http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html> MnDOT's vehicle classification scheme and vehicle class groupings for traffic forecasting can be found at:
<http://www.dot.state.mn.us/traffic/data/data-products.html#weight>

- ¹ Front axle weights of Class 9s are monitored on a monthly basis to assure performance between calibrations. The current goal of the WIM scale calibration is to have each individual axle weight stay within a range of ±9% of baseline calibration values
- ² Previous WIM research indicates that unloaded Class 9s typically weigh 28-32 kips, while loaded Class 9s generally fall in the 70-80 kip range. More recent data from several WIM sites suggests that the unloaded Class 9 range may have moved a little higher over time (due to increased presence of sleeper cabs, etc.), although these ranges are also thought to be site-specific.
- ³ An HCV is considered overweight during normal load limits in this report if they satisfy any of the following 1) exceed a gross vehicle weight (GVW) of 80,000 pounds, 2) exceed any of the legal weight maximums on any axle configurations (legal maximums are: single axle = 20,000 pounds; tandem axles spaced 8' or less = 34,000 pounds; tridem axles spaced 9' or less = 43,000 pounds; quad axles spaced 13' or less = 51,000 pounds). Monthly reports use this standard regardless of the time of year however, the Winter Load Increase (WLI) allows a 10% across the board increase in axle and gross vehicle weights without a permit on US, state routes, and county roads. An HCV is considered overweight during Winter Load Increase(WLI) if they satisfy any of the following 1) exceed a gross vehicle weight (GVW) of 88,000 pounds, 2) exceed any of the legal weight maximums on any axle configurations (legal maximums are: single axle = 22,000 pounds; tandem axles spaced 8' or less = 37,400 pounds; tridem axles spaced 9' or less = 47,300 pounds; quad axles spaced 13' or less = 56,100 pounds). An overweight HCV is only included once in the overweight volume calculations regardless of how many of the aforementioned conditions are violated. For information on MN weight limit dates and statutes:
http://www.mrr.dot.state.mn.us/research/seasonal_load_limits/sllindex.asp
- ⁴ For example, Class 9s and 10s can legally have gross vehicle weights up to 80,000 lbs (with the exception of permitted loads) during normal load limits. To account for measurement error on the WIM scales, those exceeding 10% of the legal GVW maximum (or 1.1 times the legal GVW) should be screened (e.g., 80,000 lbs + 8,000 lbs = 88,000 lbs). Similarly during WLI vehicles weighing 96,800 lbs should be screened.

To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

Figure 1 - Monthly Class 9 GVW Histogram

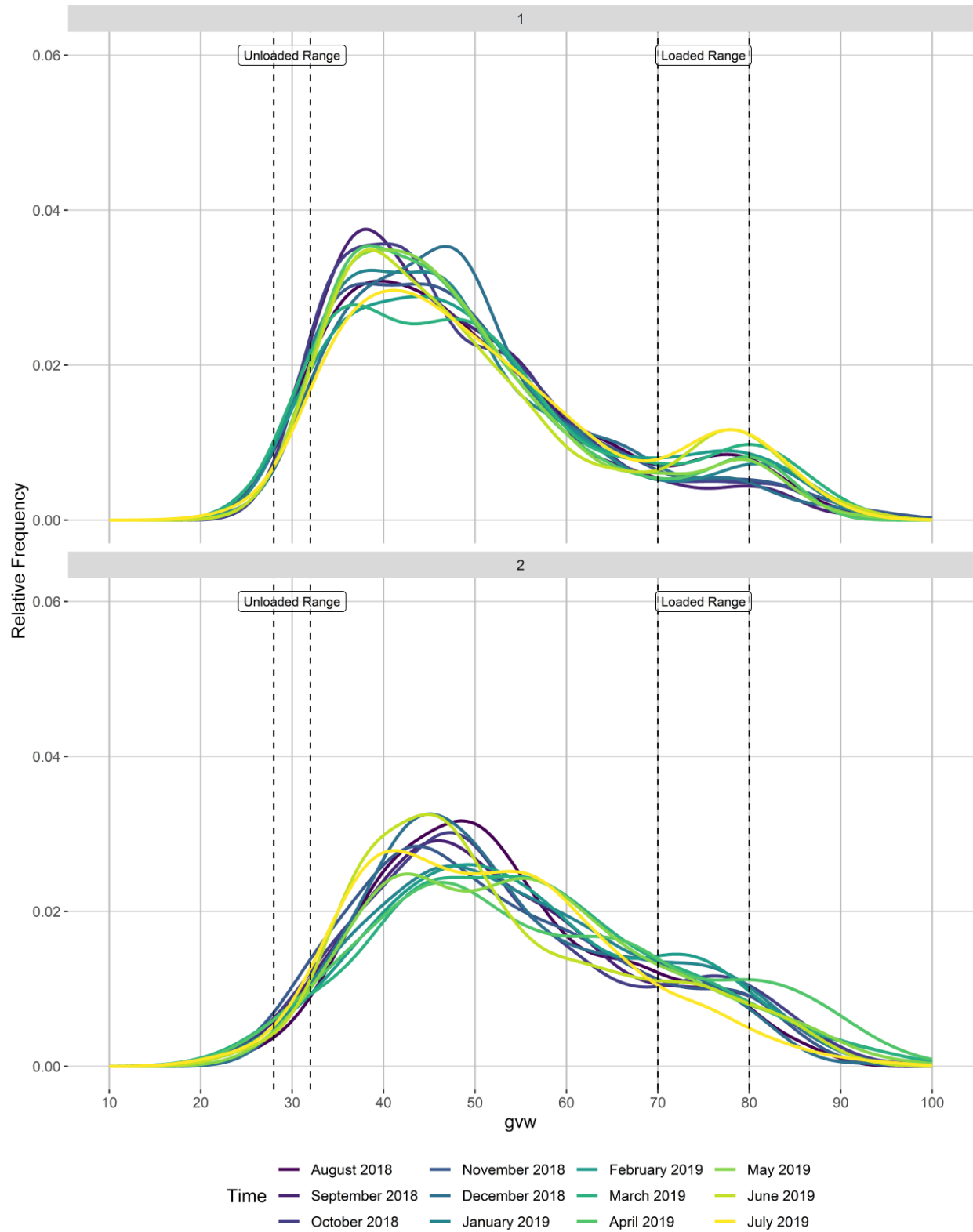
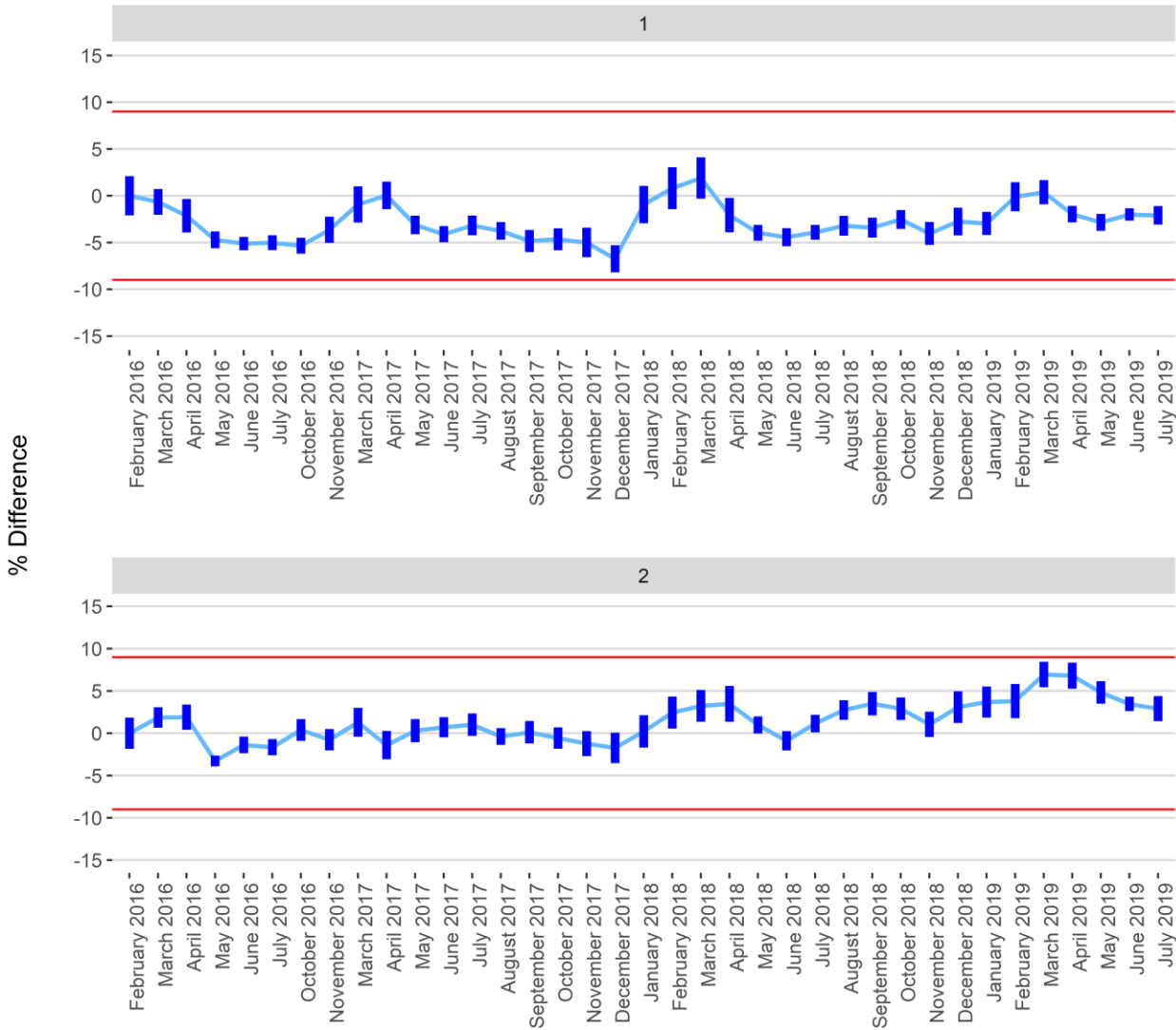


Figure 2 - Percent Difference of Front Axle Weight from
Last Calibration (+/- 95% CI)



Months that have not passed QC parameters are not displayed

Figure 2 - Average Vehicle Volume
vs. Day of the Week

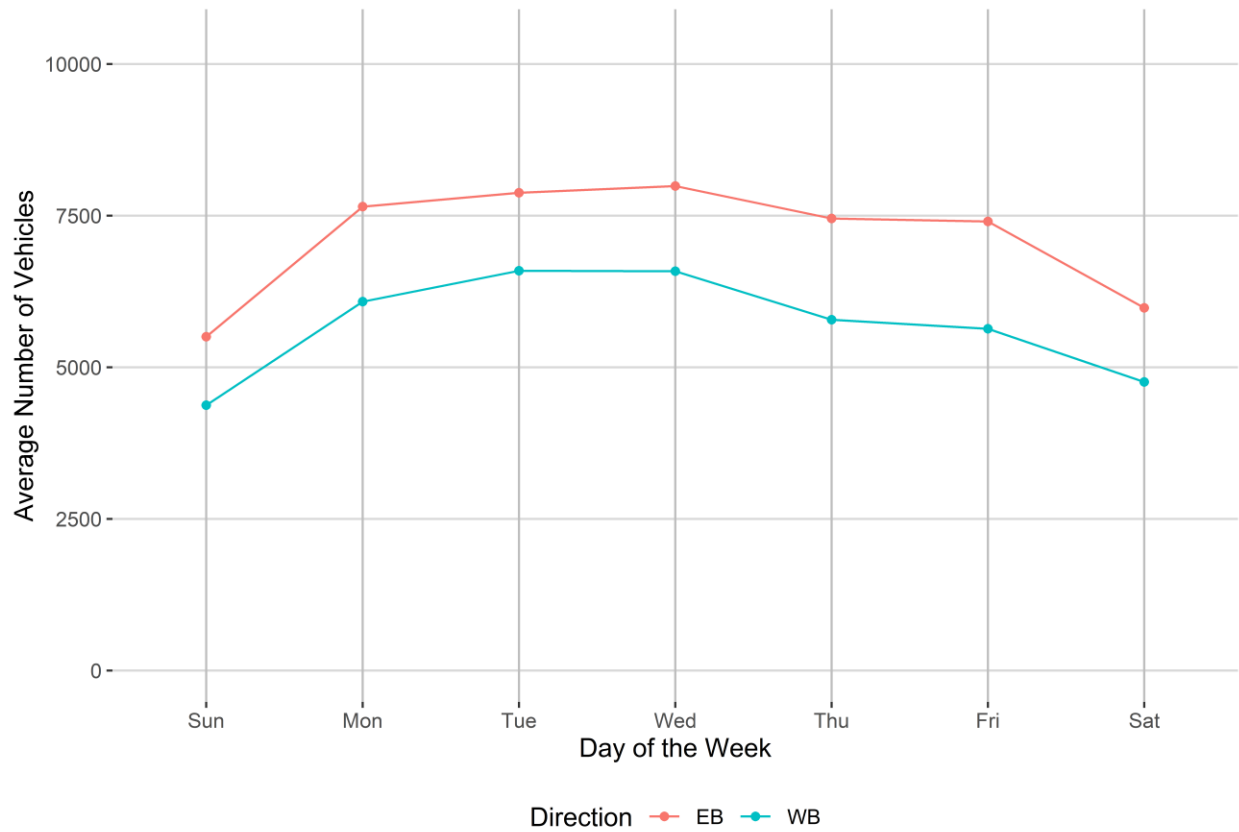


Figure 3 - Average Overweight Vehicle Volume
vs. Day of the Week

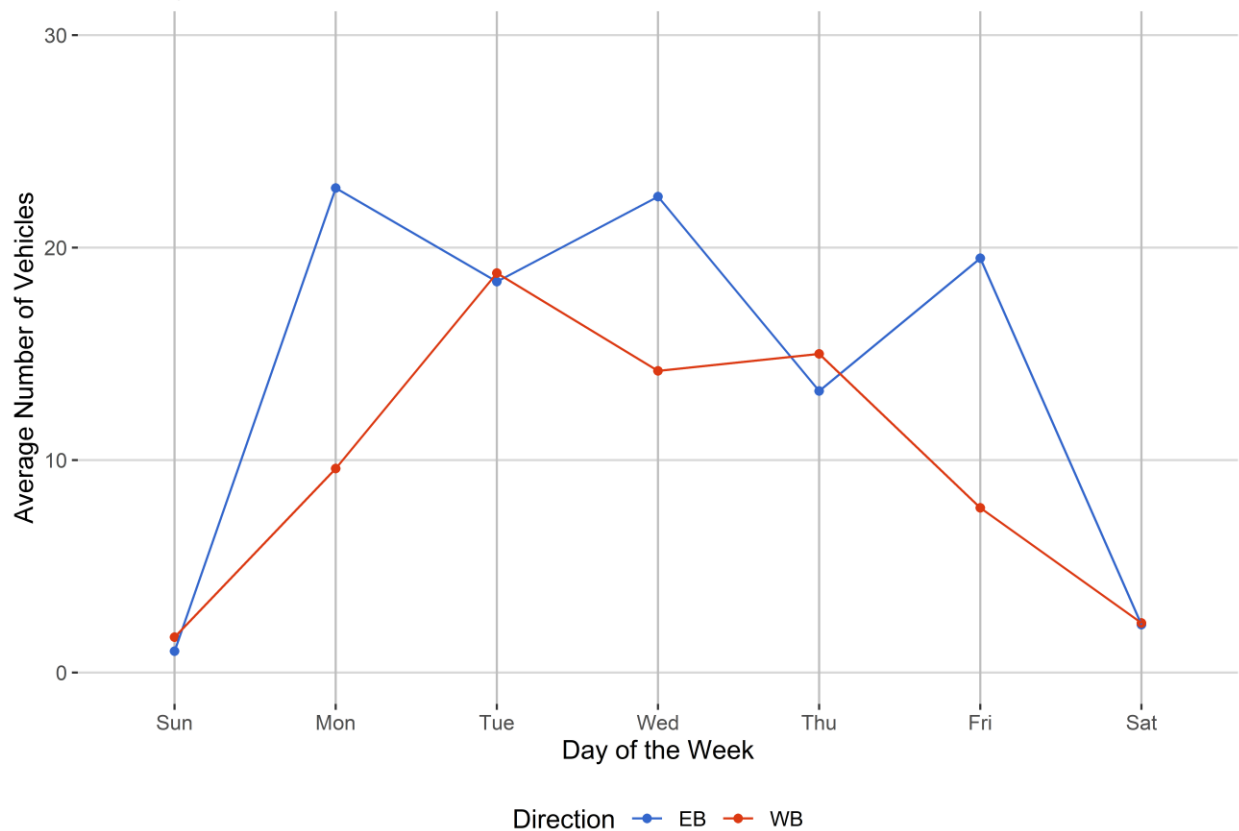


Figure 4 - Passenger Vehicles
vs. Hour of the Day

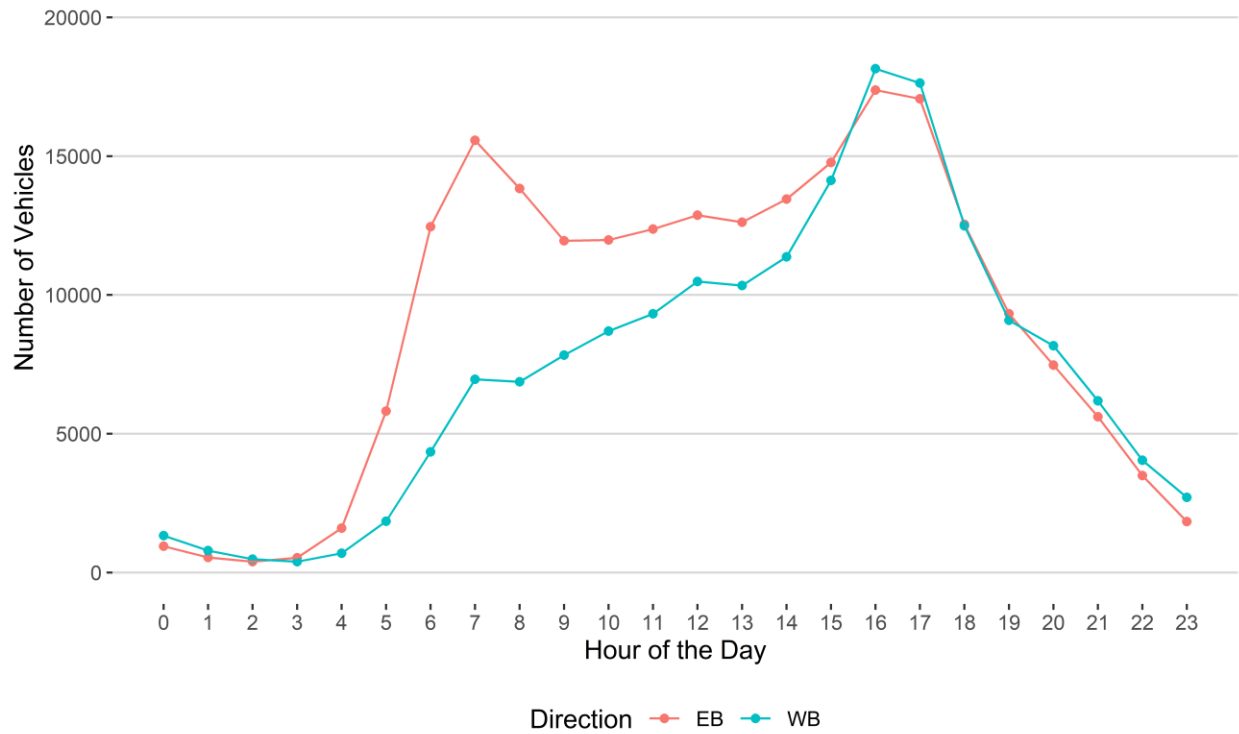


Figure 5 - Heavy Commercial Vehicles
vs. Hour of the Day

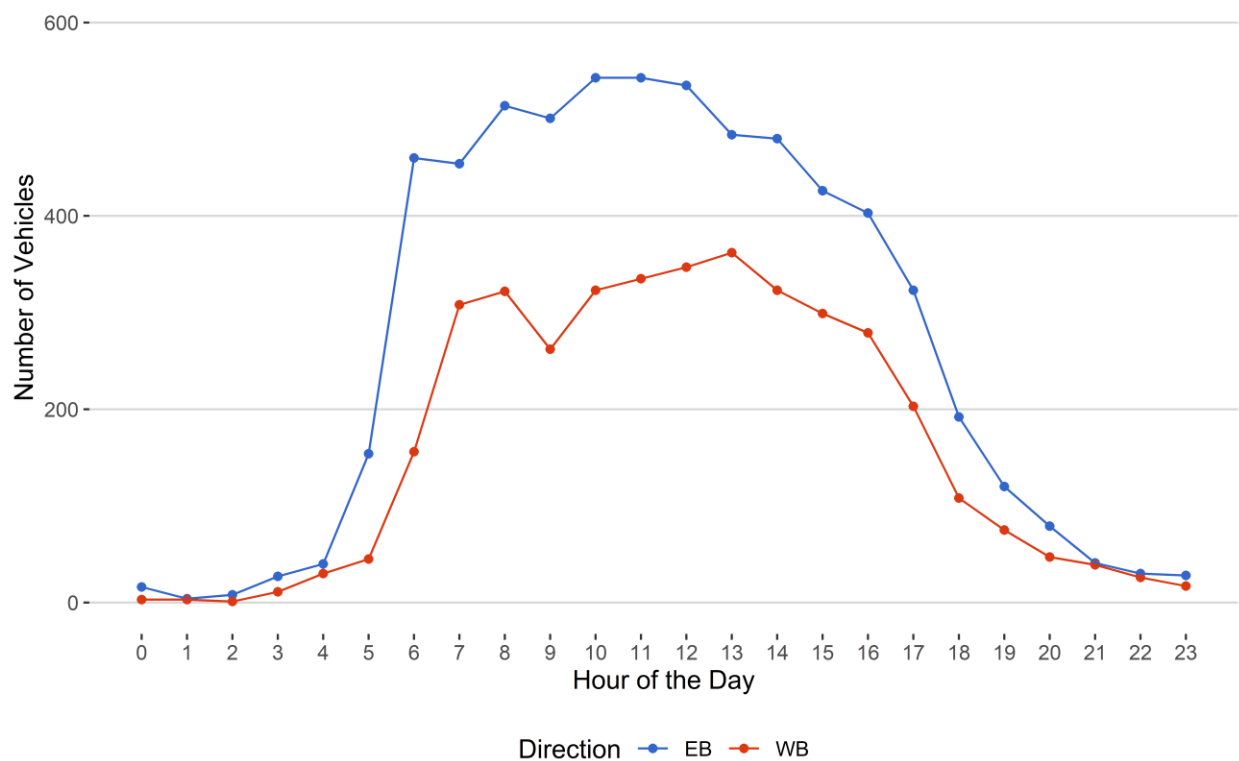


Figure 6 - Overweight Vehicles by Class
vs. Hour of the Day

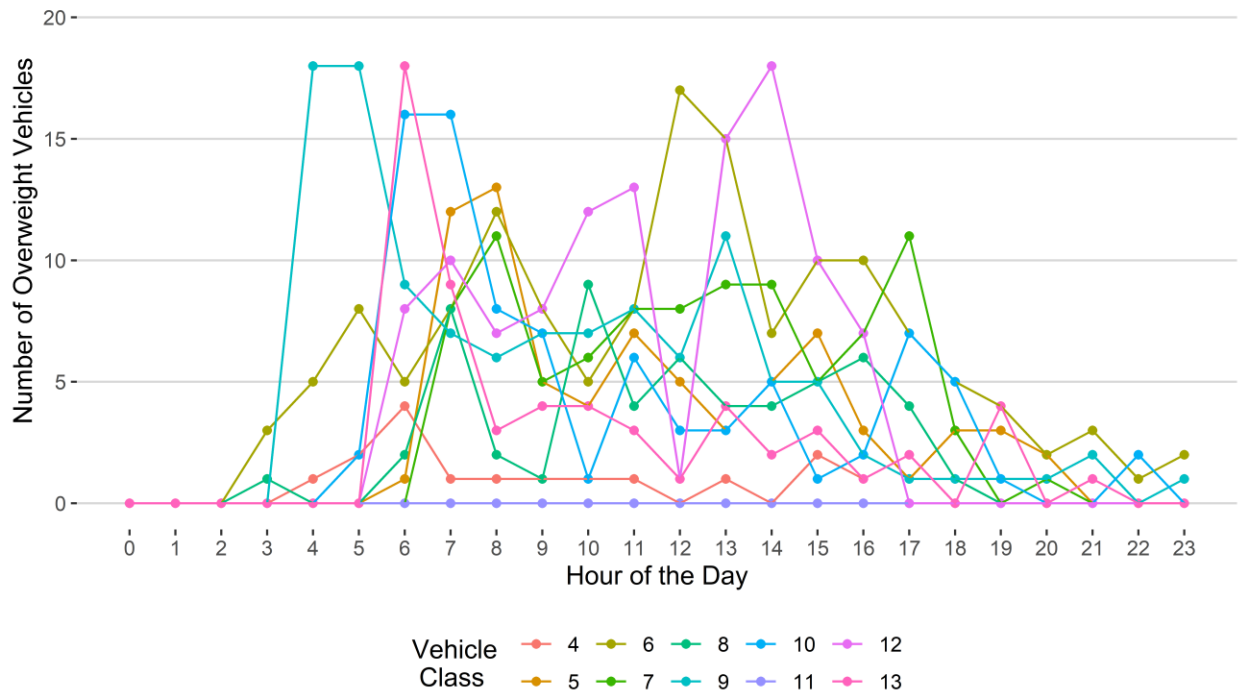


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

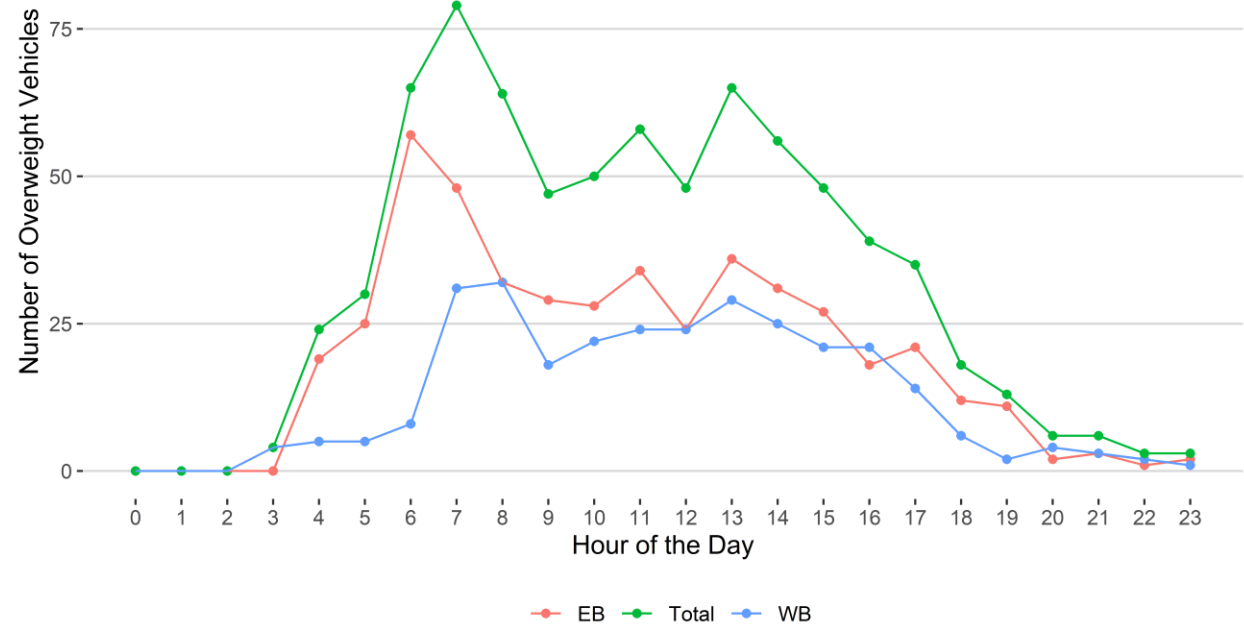
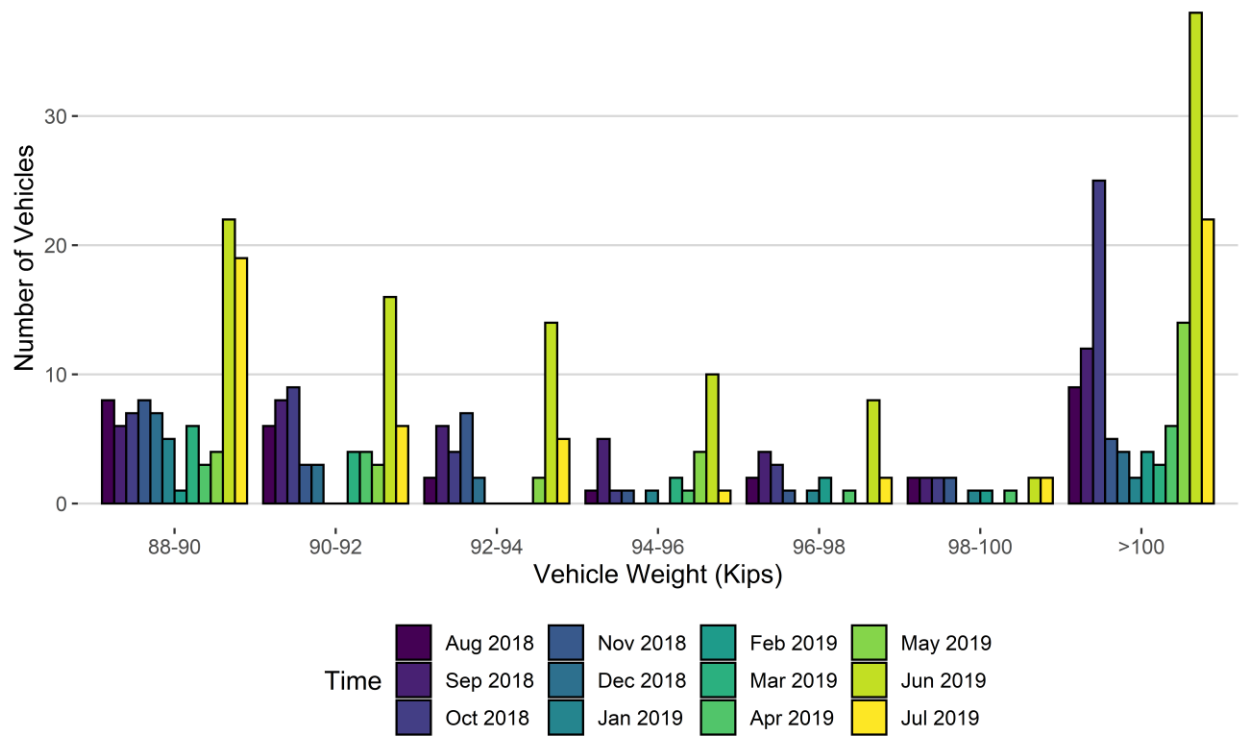
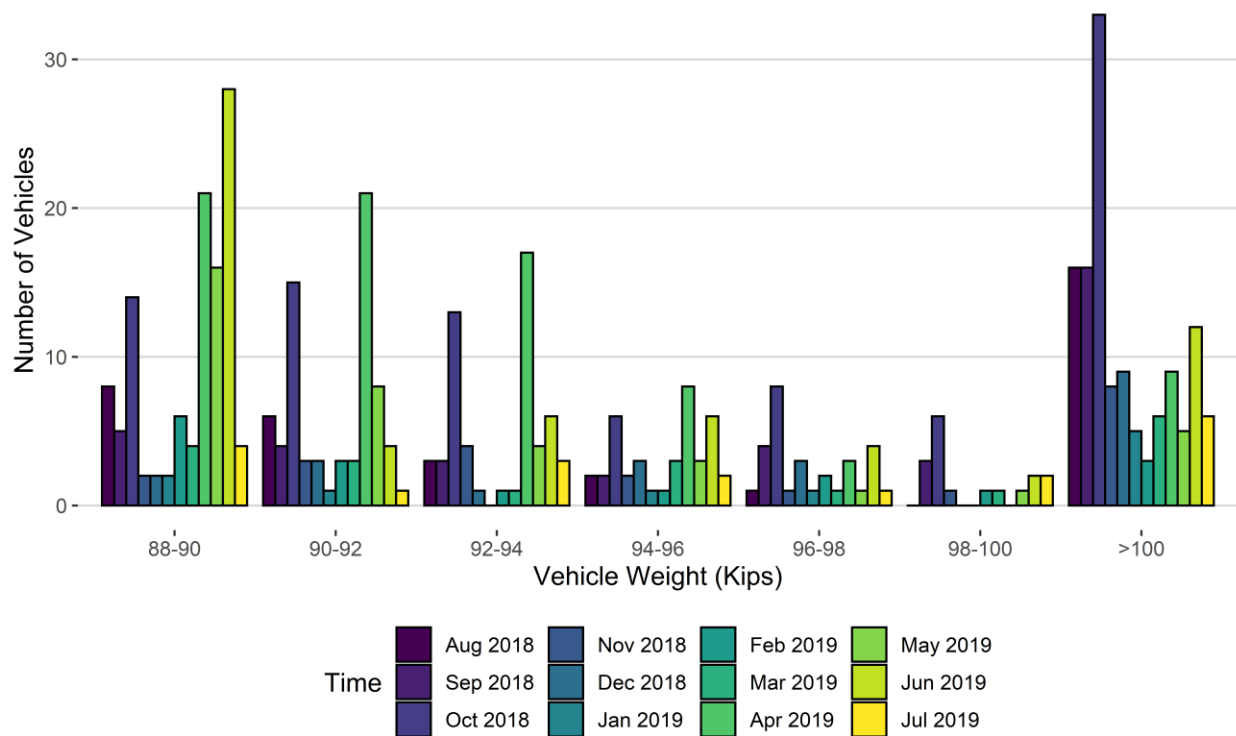


Figure 8 - Histogram of EB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019
88-90	8	6	7	8	7	5	1	6	3	4	22	19
90-92	6	8	9	3	3	0	0	4	4	3	16	6
92-94	2	6	4	7	2	0	0	0	0	2	14	5
94-96	1	5	1	1	0	1	0	2	1	4	10	1
96-98	2	4	3	1	0	1	2	0	1	0	8	2
98-100	2	2	2	2	0	1	1	0	1	0	2	2
>100	9	12	25	5	4	2	4	3	6	14	38	22
Total	30	43	51	27	16	10	8	15	16	27	110	57

Figure 8 - Histogram of WB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019
88-90	8	5	14	2	2	2	6	4	21	16	28	4
90-92	6	4	15	3	3	1	3	3	21	8	4	1
92-94	3	3	13	4	1	0	1	1	17	4	6	3
94-96	2	2	6	2	3	1	1	3	8	3	6	2
96-98	1	4	8	1	3	1	2	1	3	1	4	1
98-100	0	3	6	1	0	0	1	1	0	1	2	2
>100	16	16	33	8	9	5	3	6	9	5	12	6
Total	36	37	95	21	21	10	17	19	79	38	62	19

Figure 8 - Class 9's and 10's by Direction
vs Gross Vehicle Weight

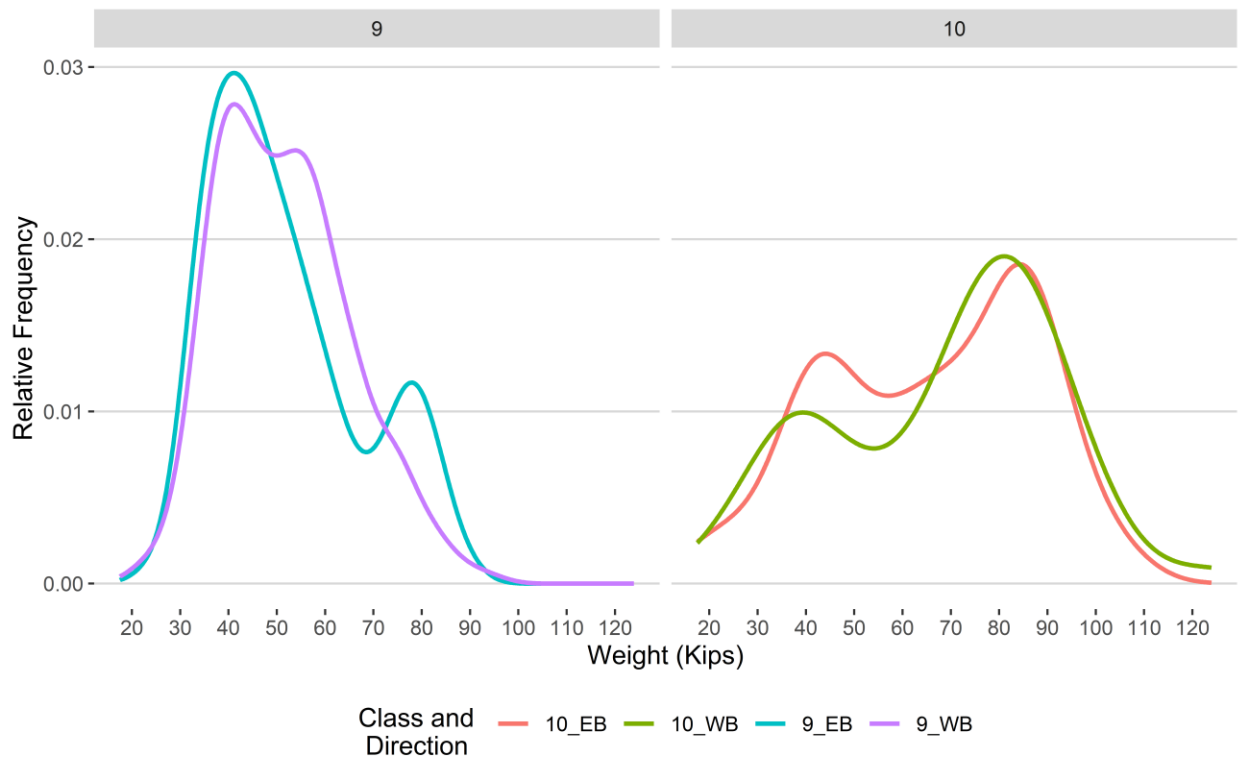


Figure 9 - Freight Percentage
by Direction and Class

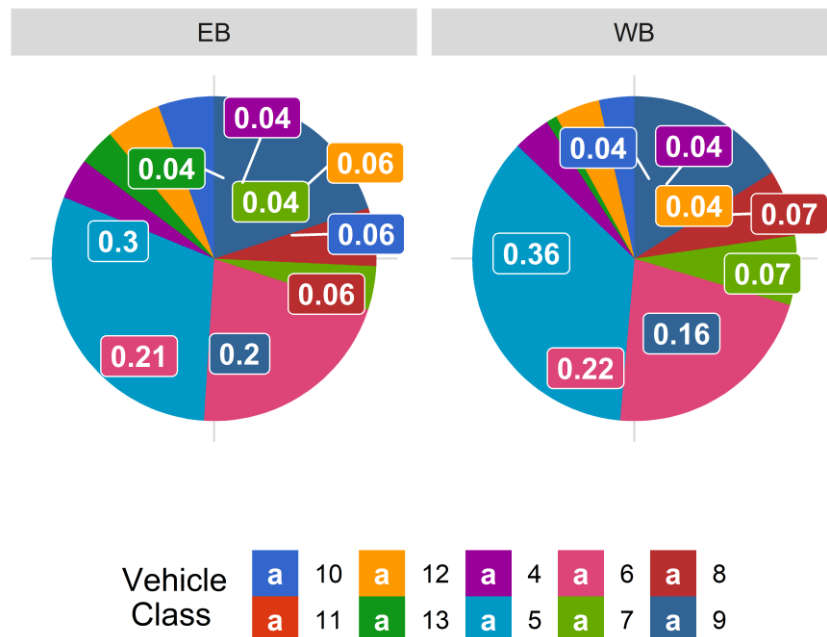


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

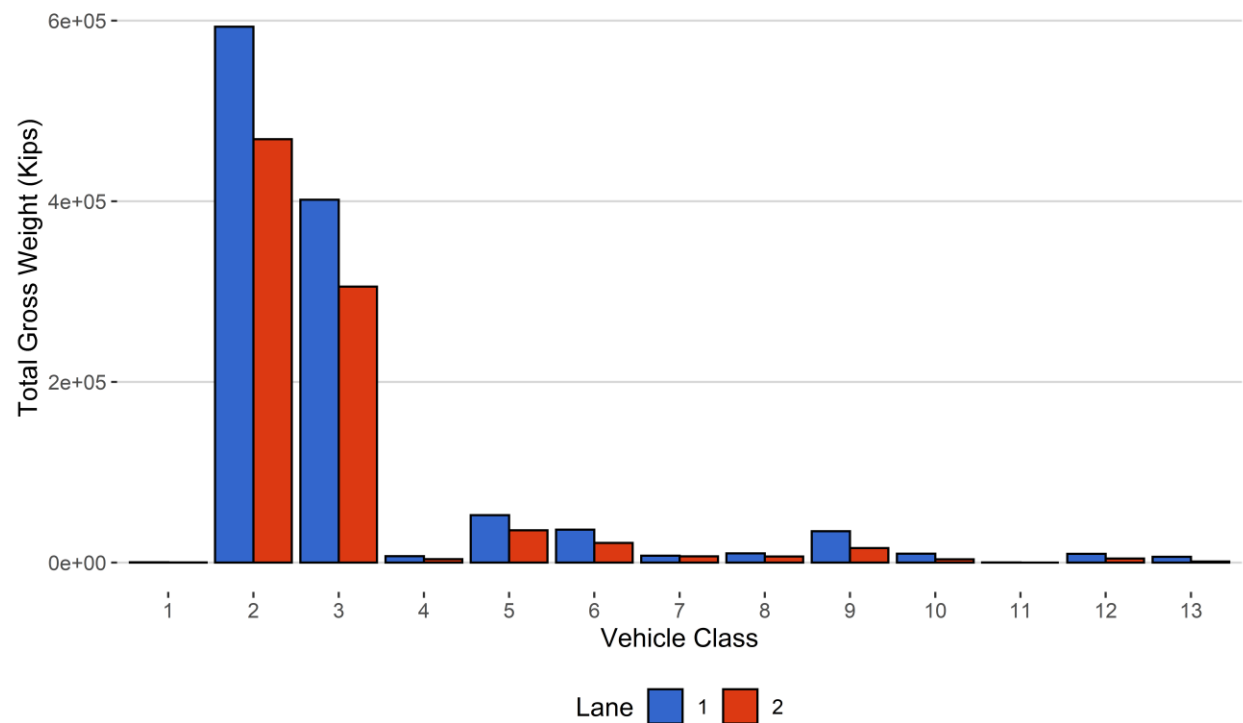


Figure 11 - Total Gross Vehicle Weight t

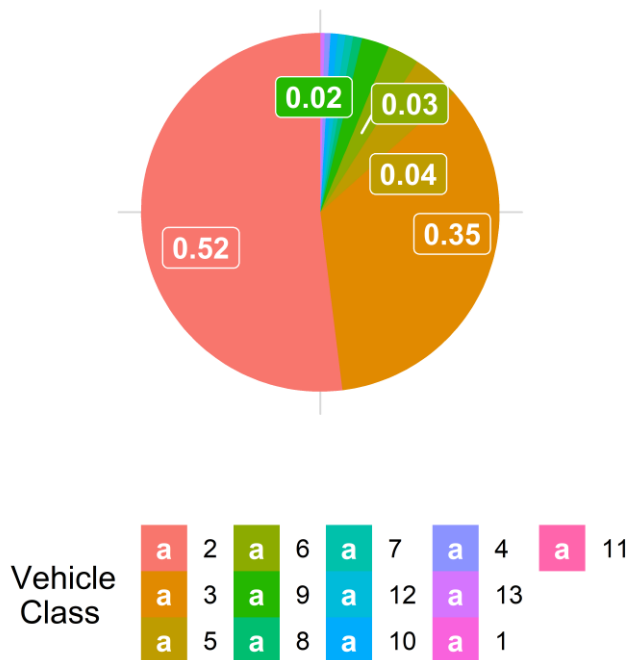


Figure 12 - Total ESALs by Class and Lane

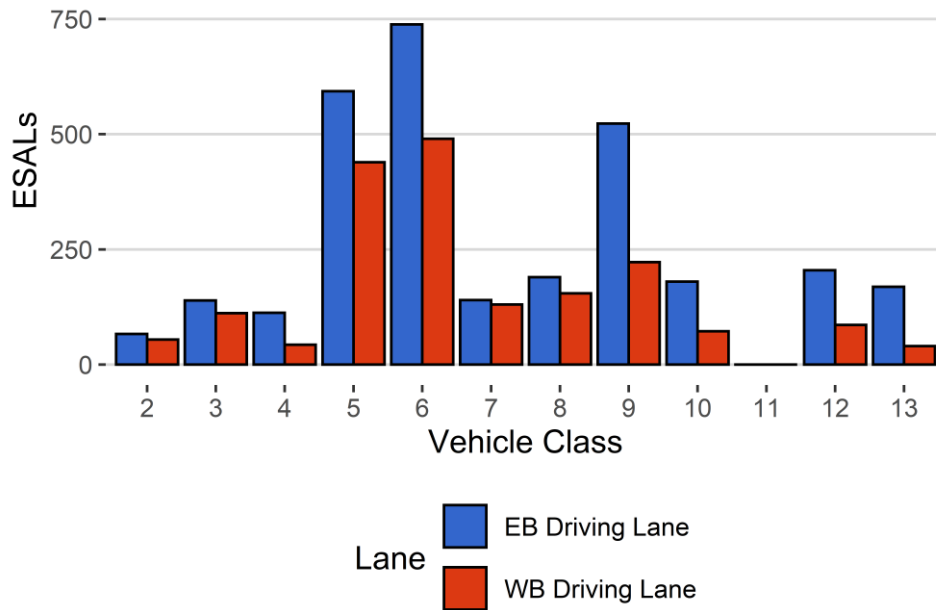


Figure 13 - ESALs by Class

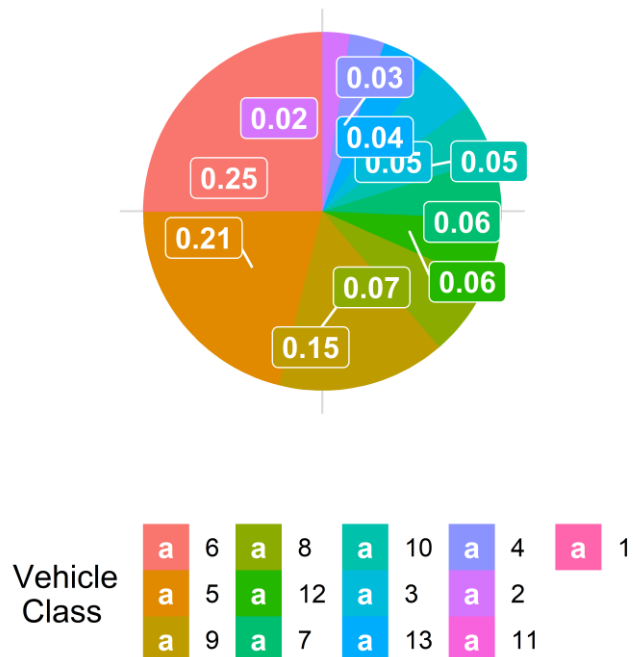


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
February 2016	11.29	0.00	10.54	0.00
March 2016	11.21	-0.66	10.73	1.86
April 2016	11.05	-2.13	10.74	1.89
May 2016	10.75	-4.71	10.19	-3.28
June 2016	10.71	-5.12	10.39	-1.38
July 2016	10.72	-5.02	10.36	-1.66
October 2016	10.68	-5.35	10.58	0.39
November 2016	10.87	-3.64	10.46	-0.76
March 2017	11.18	-0.93	10.67	1.29
April 2017	11.29	0.03	10.39	-1.41
May 2017	10.93	-3.13	10.57	0.31
June 2017	10.82	-4.11	10.61	0.71
July 2017	10.93	-3.18	10.65	1.01
August 2017	10.86	-3.76	10.50	-0.39
September 2017	10.74	-4.84	10.55	0.11
October 2017	10.76	-4.66	10.48	-0.58
November 2017	10.72	-5.00	10.41	-1.23
December 2017	10.53	-6.74	10.36	-1.74
January 2018	11.18	-0.95	10.56	0.22
February 2018	11.38	0.81	10.80	2.44
March 2018	11.50	1.90	10.88	3.23
April 2018	11.05	-2.07	10.90	3.47
May 2018	10.84	-3.96	10.64	0.98
June 2018	10.79	-4.43	10.44	-0.89
July 2018	10.84	-3.91	10.66	1.15
August 2018	10.92	-3.22	10.83	2.74
September 2018	10.90	-3.41	10.91	3.49
October 2018	11.00	-2.54	10.84	2.90
November 2018	10.83	-4.03	10.65	1.04
December 2018	10.97	-2.76	10.86	3.08
January 2019	10.95	-2.96	10.93	3.69
February 2019	11.27	-0.11	10.94	3.80
March 2019	11.33	0.37	11.27	6.95
April 2019	11.06	-1.97	11.26	6.80
May 2019	10.96	-2.85	11.05	4.82
June 2019	11.06	-2.00	10.90	3.46
July 2019	11.05	-2.10	10.84	2.90

Table 2 Vehicle Classification Data

<i>Vehicle Class</i>	<i>Monthly Average Daily Volume</i>	<i>Monthly Total Volume</i>	<i>Monthly Total Volume Percentage</i>	<i>Monthly Total Overweight Vehicles</i>	<i>Monthly Total Overweight Percentage</i>
1	14	422	0.1	0	0
2	8867	274864	68	0	0
3	3827	118638	29.3	0	0
4	13	417	0.1	18	2.4
5	199	6169	1.5	74	9.8
6	52	1610	0.4	145	19.2
7	7	231	0.1	91	12.1
8	17	513	0.1	57	7.6
9	32	988	0.2	116	15.4
10	6	199	0	85	11.3
11	0	1	0	0	0
12	6	187	0	109	14.5
13	3	82	0	59	7.8
TOTAL	13043	404321	100	754	100

Table 3 Top 10 Gross Vehicle Weight, Class 9 and 10

<i>Date</i>	<i>Day of Week</i>	<i>Time</i>	<i>Vehicle Class</i>	<i>Direction</i>	<i>Lane</i>	<i>GVW (lbs)</i>
2019-07-09	Tuesday	06:44:31	10	WB	2	123.93
2019-07-08	Monday	06:30:30	10	EB	1	106.85
2019-07-09	Tuesday	08:10:02	10	EB	1	105.27
2019-07-26	Friday	06:16:54	10	EB	1	103.93
2019-07-26	Friday	14:39:02	10	EB	1	101.74
2019-07-15	Monday	18:57:53	10	EB	1	100.48
2019-07-25	Thursday	17:57:51	10	WB	2	100.44
2019-07-19	Friday	14:08:38	10	WB	2	99.04
2019-07-15	Monday	14:00:09	10	WB	2	98.65
2019-07-10	Wednesday	09:01:34	10	EB	1	98.61

Table 4 Freight Summary

<i>Vehicle Class</i>	<i>Direction</i>	<i>Weight of Empty Vehicle (Kips)</i>	<i>Total Number of Vehicles</i>	<i>Number of Empty Vehicles</i>	<i>Percentage of Empty Vehicles</i>	<i>Total Weight of Vehicles with Freight (Kips)</i>	<i>Total Weight of Empty Vehicles (Kips)</i>	<i>Total Weight of Freight (Tons)</i>
4	EB	15	273	35	12.8	6634	448	1532
5	EB	8	3663	336	9.2	50061	2445	11723
6	EB	19	1024	10	1	36196	180	8465
7	EB	11.5	122	0	0	7563	0	3080
8	EB	31	305	135	44.3	7656	2412	1193
9	EB	33	672	45	6.7	33337	1379	6323
10	EB	33.5	147	9	6.1	9491	209	2434
11	EB	36.5	1	1	100	0	19	0
12	EB	36.5	128	0	0	9579	0	2454
13	EB	31.5	70	0	0	6361	0	2078
TOTAL	****	****	6405	571	****	166879	****	39281
<i>Vehicle Class</i>	<i>Direction</i>	<i>Weight of Empty Vehicle (Kips)</i>	<i>Total Number of Vehicles</i>	<i>Number of Empty Vehicles</i>	<i>Percentage of Empty Vehicles</i>	<i>Total Weight of Vehicles with Freight (Kips)</i>	<i>Total Weight of Empty Vehicles (Kips)</i>	<i>Total Weight of Freight (Tons)</i>
4	WB	15	141	12	8.5	3504	164	784
5	WB	8	2466	180	7.3	34293	1301	8003
6	WB	19	575	12	2.1	21478	192	5391
7	WB	11.5	107	0	0	6861	0	2815
8	WB	31	205	107	52.2	4666	1922	814
9	WB	33	310	17	5.5	15489	505	2910
10	WB	33.5	51	2	3.9	3465	47	912
12	WB	36.5	58	0	0	4450	0	1167
13	WB	31.5	11	0	0	1074	0	364
TOTAL	****	****	3924	330	****	95279	****	23158
GRAND TOTAL	****	****	10329	901	260	262158	11224	62440

Table 5 Gross Vehicle Weight by Class and Lane

<i>Vehicle Class</i>	<i>EB</i>	<i>WB</i>	<i>Total</i>	<i>Percentage</i>
1	269	161	430	0
2	593211	468675	1061886	52
3	401738	305435	707173	34.6
4	7082	3668	10750	0.5
5	52506	35594	88100	4.3
6	36376	21670	58046	2.8
7	7563	6861	14424	0.7
8	10068	6588	16656	0.8
9	34716	15994	50711	2.5
10	9700	3512	13212	0.6
11	19	0	19	0
12	9579	4450	14029	0.7
13	6361	1074	7435	0.4
TOTAL	1169188	873682	2042870	100
GVW/LANE	57.23	42.77	100	0

Table 6 ESALs by Class and Lane and Flexible ESAL Factors

<i>Vehicle Class</i>	<i>EB</i>	<i>WB</i>	<i>Total</i>	<i>Percentage</i>	<i>Flexible ESAL Factor</i>
1	0	0	0	0	0.0024
2	66	54	121	2.5	9e-04
3	139	112	251	5.1	0.0043
4	113	43	156	3.2	0.76
5	593	439	1032	21.1	0.34
6	738	490	1228	25.1	1.55
7	140	130	271	5.5	2.35
8	190	155	345	7	1.36
9	523	222	745	15.2	1.53
10	180	72	252	5.2	2.5
11	0	0	0	0	0.92
12	205	86	291	5.9	3.03
13	169	40	209	4.3	4.63
TOTAL	3057	1845	4902	100	19
ESALS/LANE	62.4	37.6	100	-	-

Table 7 Site Summary: Volume and Vehicle Class

<i>Month</i>	<i>Total Volume</i>	<i>Monthly ADT</i>	<i>Monthly HCADT</i>	<i>Passenger Vehicles</i>	<i>Passenger Vehicles %</i>	<i>Heavy Commercial Vehicles</i>	<i>Heavy Commercial Vehicles %</i>
Aug 2018	446876	14415	414	434052	97.1	12824.4	2.9
Sep 2018	419706	13990	419	407143	97	12563.1	3
Oct 2018	444856	14350	511	429029	96.4	15827.1	3.6
Nov 2018	398210	13274	359	387448	97.3	10761.7	2.7
Dec 2018	387498	12500	313	377791	97.5	9706.9	2.5
Jan 2019	367731	11862	300	358419	97.5	9311.5	2.5
Feb 2019	343809	12279	328	334638	97.3	9170.8	2.7
Mar 2019	385777	12444	286	376903	97.7	8874.2	2.3
Apr 2019	420217	14007	355	409564	97.5	10653.3	2.5
May 2019	484371	15469	467	469906	97	14465.4	3
Jun 2019	447421	14914	380	436036	97.5	11385.3	2.5
Jul 2019	404321	12901	335	393924	97.4	10396.9	2.6
TOTAL	4950793	-	-	4814853	-	135941	-
AVERAGE	412566	13534	372	401238	97	11328	3

###ESALS

<i>Month</i>	<i>ESALS EB Driving Lane</i>	<i>ESALS WB Driving Lane</i>	<i>Total ESALS</i>	<i>Pavement Life Decrease Months</i>
Aug 2018	3256	2967	6222	3.4
Sep 2018	2874	2745	5619	4.4
Oct 2018	4012	4294	8306	7.2
Nov 2018	2509	2284	4793	3.1
Dec 2018	2365	2179	4544	1.6
Jan 2019	2057	1877	3933	1.3
Feb 2019	2201	2100	4301	1.1
Mar 2019	2197	1698	3894	2.1
Apr 2019	2374	2514	4888	15.4
May 2019	3494	3224	6717	4.3
Jun 2019	6067	4480	10547	6.4
Jul 2019	3071	1861	4932	4
TOTAL	36475	-	-	-
AVERAGE	3040	2685	5725	4

###Gross Vehicle Weight

<i>Month</i>	<i>GVW EB Driving Lane</i>	<i>GVW WB Driving Lane</i>	<i>Total GVW Kips</i>
Aug 18	1207538	1132967	2340504
Sep 18	1098955	1038371	2137326

Oct 18	1261947	1190018	2451966
Nov 18	1022767	962848	1985615
Dec 18	996068	942253	1938320
Jan 19	928842	879765	1808607
Feb 19	893522	831150	1724672
Mar 19	1002496	848116	1850612
Apr 19	1090589	993366	2083955
May 19	1300770	1199019	2499789
Jun 19	2470166	2048533	4518699
Jul 19	1170043	874938	2044980
TOTAL	14443703	12941342	27385046
AVERAGE	1203642	1078445	2282087

Overweight Vehicles

<i>Month</i>	<i>Total Number of Overweight Vehicles</i>	<i>Overweight / Total Volume</i>	<i>Overweight / Heavy Commercial Volume</i>	<i>Number Over 88,000 lbs</i>	<i>Number Over 98,000 lbs</i>
Aug 2018	911	0.2	6.8	66	27
Sep 2018	745	0.2	5.8	82	35
Oct 2018	1310	0.3	7.8	148	66
Nov 2018	615	0.2	5.6	48	16
Dec 2018	693	0.2	7	37	13
Jan 2019	492	0.1	5.2	20	8
Feb 2019	553	0.2	5.9	27	11
Mar 2019	470	0.1	5.1	34	10
Apr 2019	638	0.2	5.8	95	16
May 2019	999	0.2	6.8	66	20
Jun 2019	1566	0.2	6.8	172	54
Jul 2019	761	0.2	7.2	76	32
TOTAL	9753	-	-	871	308
AVERAGE	812.8	0.2	6.3	72.6	25.7

Freight

<i>Month</i>	<i>EB Freight Tons</i>	<i>WB Freight Tons</i>	<i>Total Freight</i>	<i>EB Freight %</i>	<i>WB Freight %</i>
Aug 2018	40646	36410	77056	52.7	47.3
Sep 2018	37861	34874	72735	52.1	47.9
Oct 2018	52534	62656	115190	45.6	54.4
Nov 2018	32474	29307	61781	52.6	47.4
Dec 2018	31218	27144	58362	53.5	46.5
Jan 2019	25566	23173	48739	52.5	47.5

Feb 2019	25807	22634	48441	53.3	46.7
Mar 2019	26399	20405	46803	56.4	43.6
Apr 2019	30513	29739	60251	50.6	49.4
May 2019	45606	43096	88702	51.4	48.6
Jun 2019	76795	58724	135519	56.7	43.3
Jul 2019	39281	23158	62440	62.9	37.1
TOTAL	464700	411319	876019	-	-
AVERAGE	38725	34276.6	73001.6	53.4	46.6